

## REPORT DOCUMENTATION PAGE

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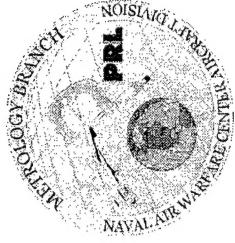
# 5700A/AN Failure Analysis

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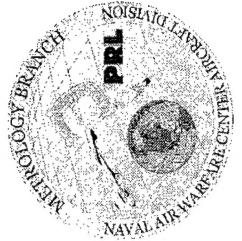
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# 5700A/AN Failure Analysis

- Introduction
  - In 1989 NAVAIR adopted the Fluke 5700A/AN Multifunction Calibrator (MFC) to replace older obsolete meter calibrators such as the Fluke 5100B.
  - Since then NAVAIR has incurred high repair costs.
  - In 1997 a project was undertaken to determine the reasons for the high repair costs.
  - This paper discusses the findings



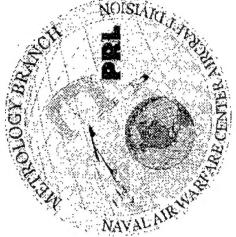
# 5700A/AN Failure Analysis

- Investigation was accomplished in three phases
  - Data Collection
  - Data Evaluation
  - Corrective Action determination and Implementation



# 5700A/AN Failure Analysis

- Data Collection:
  - Survey form was published in the Metrology Bulletin (MetBul)
  - Requested information pertaining to the use of the 5700A/AN at the time of failure.
    - ICP in use
    - Model number of the Test Instrument (TI)
    - Environmental conditions



# 5700A/AN Failure Analysis

- Data Collection:

- Survey forms submitted with the 5700A/AN at time of repair.
- Surveys were submitted for 28 5700A/AN's



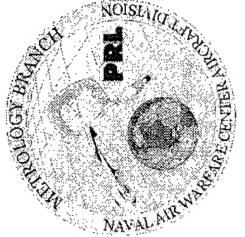
# 5700A/AN Failure Analysis

- Data Evaluation:
  - 28 Surveys were received.
    - 12 indicated the 5700A/AN failed at power up
    - 8 failed during artifact calibration
    - 8 failed while performing an ICP



# 5700A/AN Failure Analysis

- Data Evaluation:
  - 8 Failures while performing calibrations
    - 1 Failure was in the wideband oscillator, all other 5700A/AN functions worked properly.
    - 7 involved calibrating Ground Support Equipment
      - All 7 suffered catastrophic failure
  - It was decided to investigate these 7 units and the ICP's that were in use at the time of failure.



# 5700A/AN Failure Analysis

- Data Evaluation:
  - These seven 5700A/AN's and associated ICP's warranted further investigation.
  - Review the failure circumstances reported on the survey form.
  - Review the procedure for possible problems
  - Review the repair data to try and correlate the information.



# 5700A/AN Failure Analysis

- Data Evaluation:
  - Failure Scenarios
    - Failures due to aging
    - Soft failures - 5700A/AN's that were possibly exposed to a "reverse voltage" that did not result in catastrophic failure
    - Catastrophic failures - the 5700A/AN stopped working while being used - substantial "Reverse Voltage".



# 5700A/AN Failure Analysis

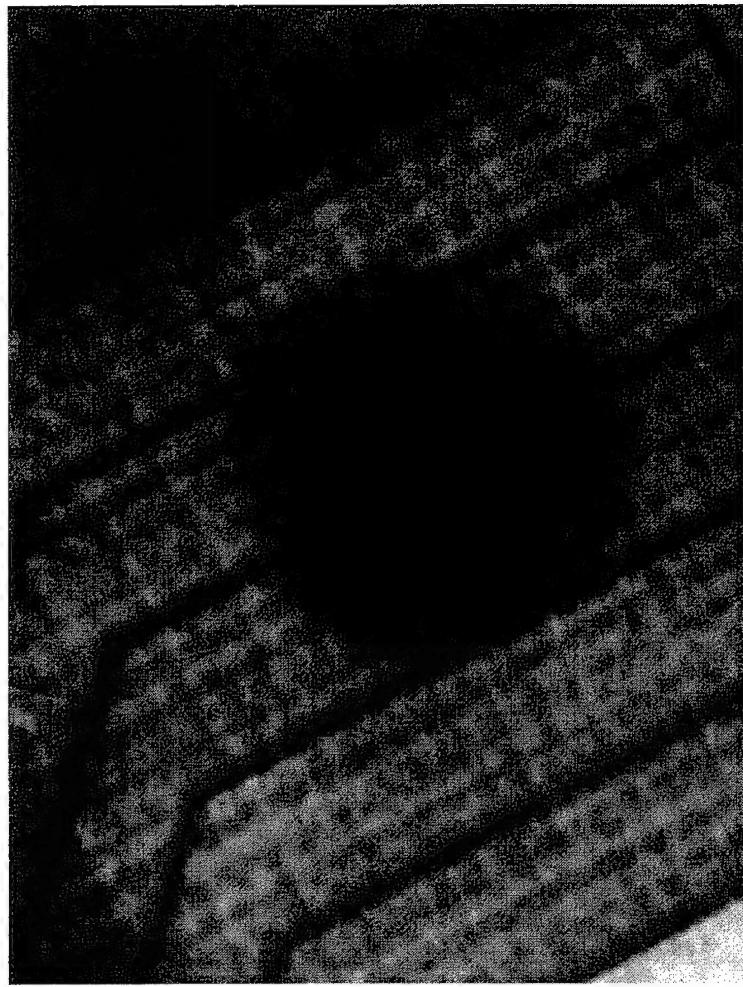
- Data Evaluation:
  - 2 scenarios involved “Reverse Voltage”



# 5700A/AN Failure Analysis

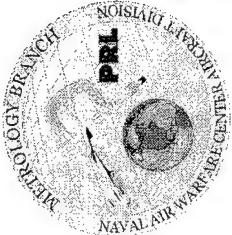
- Data Evaluation:
  - Reverse Voltage.
    - “An unexpected voltage present at the TI test points that is fed back into the 5700A/AN when it is connected to the TI.”
    - Reverse voltages of less than 3 volt may be enough to damage the 5700A/AN.
  - All seven 5700A/AN’s had damaged mother boards
    - an indicator of failure due to reverse voltage.

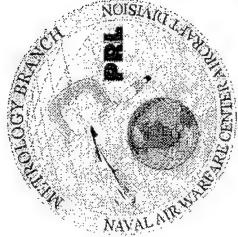
# 5700A/AN Failure Analysis



Damaged motherboard trace caused by “Reverse Voltage” being applied to the 5700A/AN.

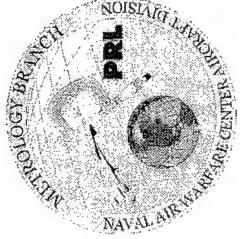
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# 5700A/AN Failure Analysis

- Data Evaluation; Sources of Reverse Voltage:
  - Defective TI
  - TI had one or more undetected electrical problems such as:
    - Floating ground
    - Wired improperly
    - Mislabeled connections



# 5700A/AN Failure Analysis

- Data Evaluation; Sources of Reverse Voltage:
  - Operator Error:
    - Connecting to the wrong test points
    - Improperly substituting the 5700A/AN for another standard.
    - Failing to follow the procedure.



# 5700A/AN Failure Analysis

- Data Evaluation; Sources of Reverse Voltage:
  - Procedural Error:
    - Not ensuring the test points are de-energized
    - Not placing the TI and/or 5700A/AN in a safe configuration before making/breaking connections.
    - Lack of appropriate WARNINGS and CAUTIONS
    - Illogical step sequences

# 5700A/AN Failure Analysis

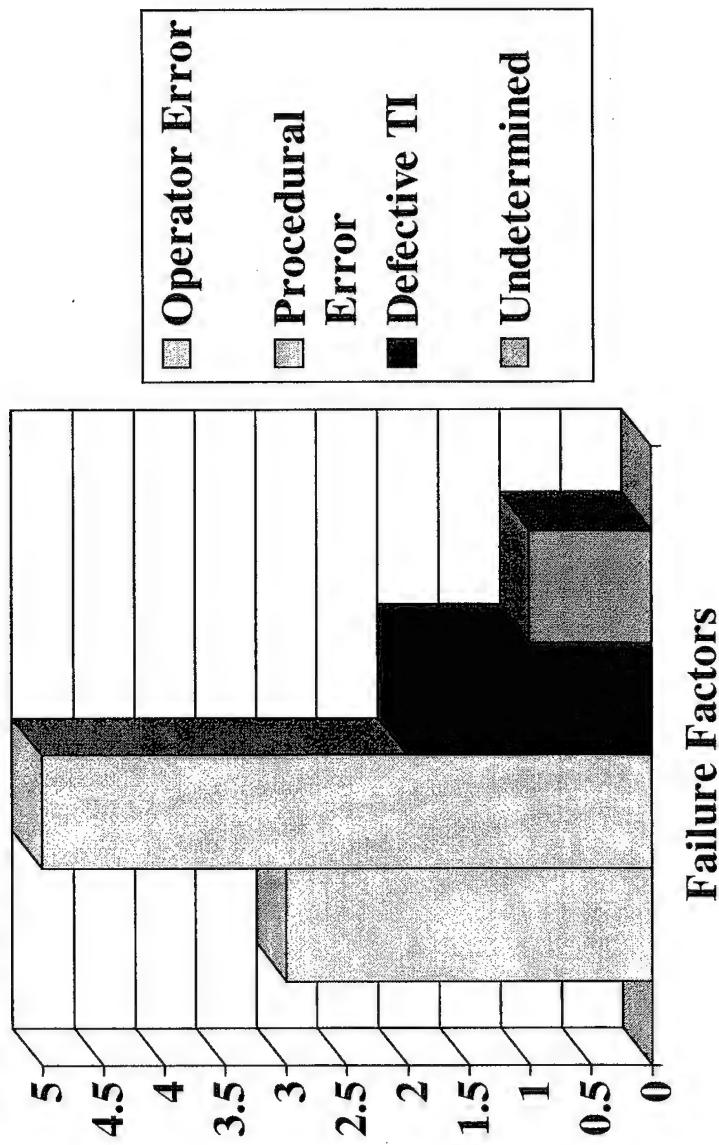


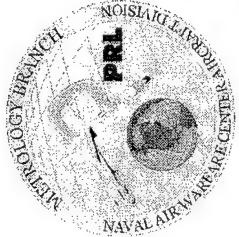
- Data Evaluation
  - In 4 of the 7 cases, more than one factor contributed to the failure.



# 5700A/AN Failure Analysis

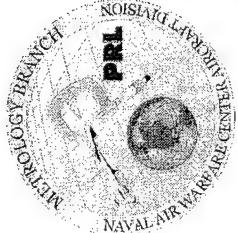
- Data Evaluation





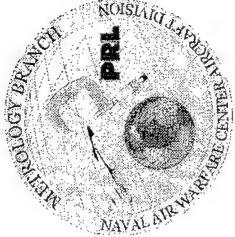
# 5700A/AN Failure Analysis

- Data Evaluation; Procedure Review:
  - The 7 ICPs were reviewed to determine if they contributed to the problem.



# 5700A/AN Failure Analysis

- Data Evaluation; Procedure Review:
  - In 5 of the 7 ICPs it was determined that they could have contributed to the failure.
    - Lacked safeguards, e.g. configuration of MFIC and/or TI
    - Improper step sequence
    - Lacked Warnings and Cautions



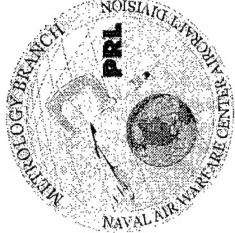
# 5700A/AN Failure Analysis

- Data Evaluation; Procedure Review:
  - Additionally, in some ICPs the performance specifications of the TI did not warrant using a 5700A/AN.



# 5700A/AN Failure Analysis

- Corrective Action:
  - Developed guidelines using 5700A/AN's in ICPs
    - Ensuring test points are de-energized.
    - Safeguarding the 5700A/AN when making/breaking connections.
    - Ensuring the step sequence is logical.
    - Ensuring appropriate WARNINGS and CAUTIONS are used and properly placed in the ICP.
  - Ensure the 5700A/AN is the appropriate standard to use.



# 5700A/AN Failure Analysis

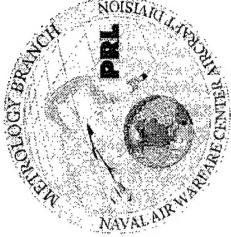
- Corrective Action:
  - Training
    - Use MetBul articles to inform and remind technicians of proper use of the 5700A/AN.
  - Substitution:
    - Select an alternate standard or methodology when the TI performance specifications allow it.



# 5700A/AN Failure Analysis

- Conclusions:

- The most likely cause of damage to NAVAIR 5700A/AN meter calibrators is the application of a “Reverse Voltage” to the 5700A/AN.
- Several of the ICPs examined during this project lacked fundamental measurement practices and safeguards, and therefore could have contributed to damaging the 5700A/AN.



# 5700A/AN Failure Analysis

- Conclusions:
  - Operators need to be aware of limitations associated with the use of the 5700A/AN